THE

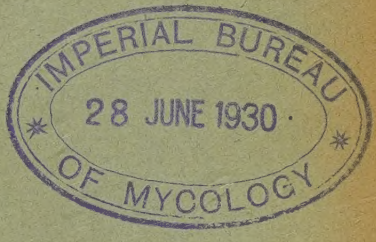
Tea Research Institute

OF

Ceylon.

BULLETIN No. 4.

Annual Report for the Year 1929.



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THE TEA RESEARCH INSTITUTE OF CEYLON,
VICTORIA COMMEMORATION BUILDINGS, KANDY.

THE TEA RESEARCH INSTITUTE.

BOARD OF CONTROL.

(A) Representing the Planters' Association of Ceylon:—

(1) Mr. D. S. Cameron.

(2) Mr. R. G. Coombe (Chairman).

(3) Mr. J. Horsfall.

(B) Representing the Ceylon Estates Proprietary Association:-

(4) The Hon. Mr. J. W. Oldfield. *(on leave).*
Major H. Scoble Nicholson, O.B.E., *(acting).*

(5) Mr. J. D. Finch Noyes. *(on leave).*

(6) Mr. P. A. Keiller.

(C) Representing the Low-Country Products' Association:—

(7) The Hon. Mr. D. S. Senanayeke.

(D) Representing the Small-Holders:—

(8) Mr. T. B. Panabokke.

(E) Ex-Officio Members:—

(9) The Hon. the Colonial Treasurer.

(10) The Director of Agriculture.

(11) The Chairman, Planters' Association of Ceylon.

(12) The Chairman, Ceylon Estates Proprietary Association.

Secretary, Mr. A. W. L. Turner, Victoria Commemoration Buildings, Kandy.

REPORT

OF THE

BOARD OF THE TEA RESEARCH INSTITUTE OF CEYLON

FOR 1929.

Foundation:—The Institute was established and the Board of Management thereof was incorporated by Ordinance No. 12 of 1925, dated the 27th October, 1925.

Board of Management:—On the 1st January, 1929, the Board of Management consisted of the following Members:—

Ex-Officio Members.

1. The Hon'ble the Colonial Treasurer, (Mr. W. W. Woods)
2. The Director of Agriculture, (Dr. W. Small,) (Acting)
3. The Chairman, P. A. of Ceylon, (Mr. E. C. Villiers)
4. The Chairman, C. E. P. A. (Mr. H. F. Parfitt)

Representatives of the P. A.

5. Mr. R. G. Coombe
6. Mr. John Horsfall
7. Mr. D. S. Cameron

Representatives of the C. E. P. A.

8. The Hon'ble Mr. J. W. Oldfield, O.B.E.
9. Mr. J. D. Finch Noyes
10. Mr. P. A. Keiller

Representative of the L. C. P. A.

11. The Hon'ble Mr. D. S. Senanayake, M.L.C.

Representative of the Small Holders.

12. Mr. T. B. Panabokke

Mr. R. G. Coombe continued as Chairman of the Board and Mr. A. W. L. Turner as Secretary.

Mr. H. F. Parfitt resigned the Chairmanship of the Ceylon Estates Proprietary Association in March and was automatically succeeded on the Board by the new Chairman, Mr. W. Coombe.

Messrs. R. G. Coombe and John Horsfall were granted leave of absence and proceeded on furlough in April and June, respectively. The Planters' Association elected Messrs. C. Huntley Wilkinson and C. C. du Pré Moore to serve on the Board until their return. Mr. Horsfall returned in October and relieved Mr. du Pré Moore. Mr. R. G. Coombe returned in November and relieved Mr. Huntley Wilkinson.

Mr. T. B. Panabokke was granted leave in May and His Excellency the Governor nominated Mr. M. B. Galagoda, Basanayke Nilame, to represent the Small Holders until Mr. Panabokke resumed his duties in December.

The Hon'ble Mr. J. W. Oldfield and Mr. J. D. Finch Noyes were granted leave of absence and proceeded on furlough in October and the Ceylon Estates Proprietary Association elected Major H. Scoble Nicholson, O.B.E., and Mr. C. H. Figg to serve on the Board until their return.

Chairman.—When Mr. R. G. Coombe proceeded on furlough, the Hon'ble Mr. J. W. Oldfield was elected Acting Chairman and on his proceeding on leave, Mr. Huntley Wilkinson acted until Mr. R. G. Coombe resumed duties in November.

Meetings of the Board:—During the year the Board held two Board Meetings in Kandy and two Meetings in Colombo. The average attendance was 10.

Estate Sub-Committee:—This Sub-Committee consisted of:—

The Chairman (Mr. R. G. Coombe), the Hon'ble Mr. J. W. Oldfield, Messrs. P. A. Keiller, E. C. Villiers, J. W. Ferguson and John Horsfall.

This Sub-Committee met on three occasions.

Committee for Agricultural Experiments:—

This Committee was appointed on the 9th April.

Personnel:—The Director of the Institute, the Agricultural Chemist, the Visiting Agent, the Superintendent of St. Coomb's Estate, and Messrs. John Horsfall and C. C. du Pré Moore and the Chairman.

This Committee met on one occasion.

Estimating Sub-Committee:—This Sub-Committee was appointed on the 30th September to draw up the estimates for 1930.

This Sub-Committee consisted of:—

The Chairman (Mr. R. G. Coombe), the Director, T.R.I., the Visiting Agent and the Secretary.

This Sub-Committee met on two occasions.

Visiting Agent:—Mr. J. W. Ferguson of St. Clair Group, Talawakelle, continued as Visiting Agent. He attended three meetings of the Board by invitation.

Scientific Staff:—

Director:—Mr. T. Petch, B.A., B.Sc., appointed on the 8th March 1926, severed his connection with the Institute on the 30th April. He was succeeded by Dr. R. V. Norris, D.Sc., F.I.C., late Professor of Bio-Chemistry, Indian Institute of Science, Bangalore. He commenced his duties in Ceylon on the 12th August.

Dr. C. H. Gadd acted as Director of the Institute until he proceeded on nine months' furlough, when Mr. T. Eden took up the acting appointment until relieved by Dr. R. V. Norris.

The selection of a Director, Entomologist and a Plant Physiologist was left in the hands of a Selection Committee in London, subject to the Board having power to make the final choice. This Selection Committee was composed of:—

Dr. A. W. Hill, C.M.G., Director, Royal Botanical Gardens, Kew, Surrey, England.

Sir John Russell, F.R.S., Rothamsted Experiment Station, Harpenden, Herts, England.

Sir John B. Farmer, F.R.S., Royal College of Science and Technology, South Kensington, London, S.W.

Mr. F. A. Stockdale, Assistant Agricultural Adviser to the Secretary of State for the Colonies.

Mr. S. A. Neave, Acting Director, Imperial Bureau of Entomology, London.

Later Messrs. R. G. Coombe and John Horsfall served on this Committee.

The Board desires to record its appreciation of the services rendered by this Committee.

Department of Agriculture:—The Board wishes to record its thanks to the Acting Director of Agriculture for having obtained permission from Government to allow two Officers of his Department to carry on the Advisory, Mycological and Entomological work of the Institute in addition to their own duties during Dr. Gadd's absence on leave and during the period the Institute was without an Entomologist, owing to Mr. Light's resignation.

St. Coombs Estate:—

As was stated in the last Annual Report the Institute purchased this property in December, 1928. During this year the property was surveyed by Mr. Philip Fowke and the area accepted by the Board was:—

423 Acres, 2 Roods, 12 Perches, made up as follows:—

	A.	R.	P.
Tea in bearing	165	0	16
New clearings	74	1	34
Patna and Swamp	184	0	02
	423	2	12

With regard to this Estate it should be recorded that at the time of purchase no Factory, Superintendent's Bungalow, Tea Maker's House, etc., existed. During the year under review a factory has been erected. A Superintendent's Bungalow and a Tea Makers's House and 40 room lines have been built and the cart road extended from Mattakellie Estate past the Factory to the Laboratory and Staff Bungalow sites.

Laboratories:—Throughout the year the research work was carried out in the temporary laboratory at "Lindfield" Nuwara Eliya, but it is expected that before the next Annual Report the Headquarters of the Institute will be established in well-equipped Laboratories on St. Coombs Estate. The Bungalow on Mahagalla Estate, Maskeliya continued to be used throughout the year for experiments in breeding Trichogramma.

Bungalows:—During August the contract documents were signed for the erection of four Senior Scientific Staff and three Junior Scientific Staff Bungalows. The Senior Scientific Staff Bungalows are of the same plan as the Superintendent's Bungalow and plans of the Bungalows and Laboratories have been reproduced in the *Tea Quarterly* Vol. II, Part 4.

Factory:—The building of the Factory was commenced in March and completed to enable manufacture to commence in October, the machinery is driven by electric motors.

A full description and plan of the Factory will be found in the *Tea Quarterly* Volume 11, Part 2.

The Board desires to record its thanks to Mr. F. J. Whitehead for his valuable services and advice as Consulting Engineer.

It also desires to record its appreciation of the good work done by Messrs. the Colombo Commercial Company for erecting the modern and up-to-date Factory and Machinery.

Its thanks are also due to the undermentioned Firms for supplying the various machinery at reduced costs :—

Messrs. the Colombo Commercial Co., Ltd.
,, Davidson & Company.
,, Walker, Sons & Co., Ltd.

Tea Research Conference:—The First Conference of the Tea Research Institute was held in the Head Office of the Department of Agriculture, Peradeniya on the 11th March, and was well attended. It is proposed to hold this Conference biannually alternately with the Conferences organised by the Department of Agriculture.

Publications:—Since The *Tea Quarterly* was first issued in 1928, the number of copies distributed has increased from 1105 to 1182. Up to the end of 1929, the Institute has issued three Bulletins and two volumes of the *Tea Quarterly*. Of these Publications the following numbers of the Bulletins and *Tea Quarterly* are out of print :—

Bulletin No. 3.
Tea Quarterly Vol. I, Parts 3 and 4.
Do Vol. II, Parts 1 and 2.

They may, however, be reprinted should it be considered necessary to do so.

The Board has also considered the question of issuing pamphlets in the Vernacular and this may possibly be accomplished during 1930.

Free issues of these Publications are made to all registered Superintendents and Proprietors of Tea Estates. Additional copies can also be sent to all Assistant Superintendents of Tea Estates in Ceylon on application to the Secretary.

The annual subscription for other persons desirous of receiving the Institute's Publications is Rs. 15-00 for those resident in Ceylon or India, and £1-5-0 elsewhere.

Individual copies of the Publications can be had at Rs. 2-50 each.

Finance:—The Statement of Accounts is attached.

During the year the Board made an application to the Empire Marketing Board for a sum of £2,000-0-0 a year for three years for an investigation of the biological control of insect pests of tea and other crops in Ceylon and a grant of £1,000-0-0 towards the purchase of experimental small scale machinery and plant for the factory of the Tea Research Institute.

Visitors' Day:—Visitors are welcome on any day but they will of course, receive more attention if they make their visit on Visitors' Day, the date of which is the first Wednesday in each month.

A. W. L. TURNER,
Secretary.

REPORT

OF

THE DIRECTOR,

TEA RESEARCH INSTITUTE OF CEYLON

FOR 1929.

Staff:—Pending the appointment of a new Director in succession to Mr. Petch, Dr. Gadd acted as Director until he proceeded on home leave in May from which time Mr. Eden officiated until the writer took over charge in August.

Mr. S. Stuart Light resigned at the end of June, and the Institute was without an Entomologist until December, when Mr. C. B. Redman King, M.A., joined the staff.

Mr. F. R. Tubbs, M.Sc., D.I.C., A.R.C.S., was appointed as Plant Physiologist from 1st August, but was deputed for further specialised training at the East Malling and Long Ashton Research Stations, and is not expected to arrive in Ceylon until early in 1930. Dr. Gadd was on leave from May 8th to the end of the year.

Mr. A. T. Wirasinha resigned from the Junior Staff during the year and was succeeded by Mr. E. N. Perera, while Mr. V. Mendis was appointed as Assistant to the Biochemist. Considerable additions to the Junior Staff, including the appointment of two more highly qualified Research Assistants, have been sanctioned by the Board, but owing to limited accommodation at present available such staff cannot be recruited until the move to the new Laboratories is made.

Laboratories and Buildings:—The staff, with the exception of the Entomologist who continued to work at Mahagalla, were accommodated at the temporary laboratory at Nuwara Eliya throughout the year. Construction of the new Laboratory at St. Coombs was, however, commenced late in the year, and it is anticipated that this will be completed by the end of August, 1930.

The new Laboratory is a single storey building consisting of two main wings for the chemical and biological departments respectively, connected by two smaller blocks containing accommodation for the offices and library and a photographic room. The buildings will, it is believed, offer full facilities for the investigation of all major problems of the tea industry on up-to-date lines. A fuller description will be found in the *Tea Quarterly*, 1929, Vol. II, page 127.

Work was also commenced on the Staff Bungalows. The building programme sanctioned provides for six Senior Staff Bungalows, ten Junior Staff Bungalows and accommodation for clerks, laboratory peons and other necessary subordinate staff. Financial considerations do not permit of the whole of this pragramme being carried out immediately. It is, however, anticipated that sufficient accommodation will be available before the end of 1930 to enable the staff to move to St. Coombs.

St. Coombs Estate:—This estate of 423 acres was acquired in December 1928, and considerable developments have taken place during the year in addition to the building programme outlined above for the Research Department. A Factory on up-to-date lines to the designs of the Colombo Commercial Company was completed in October, and manufacture began in that month. This Factory presents several interesting features, an account of which will be found in the *Tea Quarterly,* 1929, Vol. II, page 38. It is gratifying to record that satisfactory prices for St. Coombs tea have been consistently obtained.

In addition to the present equipment it is proposed, however, to add to the factory small scale experimental machinery which will provide facilities for the manufacture of small quantities of leaf under controlled conditions, and enable tests to be carried out on the leaf obtained from the experimental plots. To meet the cost of such plant the Board has applied to the Empire Marketing Board for a grant.

A bungalow for the Superintendent and quarters for the Teamaker have also been completed during the year, together with a pump house, office, store, 40 room lines and other miscellaneous buildings.

It is the intention to develop the larger area of the estate on commercial lines setting aside some 60-70 acres for experimental purposes. In order that such experimental work may be developed on sound lines, an Experimental Sub-Committee has been set up which will consider all major proposals for field work. During the year this Committee consisted of the Director of the Institute, the Agricultural Chemist, the Chairman of the Board, the Visiting Agent, the Superintendent, and Messrs. John Horsfall and C. C. du Pré Moore.

Visitors' Day:—The first Wednesday in each month has been set aside as a Visitors' Day when facilities are given for visitors to inspect the factory and estate. A considerable number of planters have availed themselves of the opportunity thus provided.

Library:—While no large additions have been made to the Library during the year, the policy of exchanging publications with other scientific institutes has been extended, and in this way the number of journals and scientific papers received shows a steady increase. Thanks are also due to various donors for the gifts of books and pamphlets.

Publications:—It is satisfactory to record that the demand for the *Tea Quarterly* increases rapidly, and this has necessitated raising the number of copies printed to 1500.

Institute Conference:—The first Conference of the Tea Research Institute was held in March at Peradeniya by courtesy of the Director of Agriculture, and was well attended. Papers were read by the Institute Staff, by Mr. F. J. Whitehead and Mr. E. E. Meggett on all of which interesting discussions arose, a report of which will be found in the *Tea Quarterly,* 1929, Vol. II, page 25. Such Conferences afford a valuable opportunity for co-ordinating the work of the Institute with practical field experience, and it is proposed to hold them biannually, alternately with the Conferences of the Department of Agriculture.

Work of the Staff.

The correspondence passing through the Director's office during the year comprised 2264 letters in and 1927 letters out.

Addresses were given by the Director at meetings of the Dickoya and Dimbula Planters' Association, by the Biochemist to the Dimbula P. A. and by the Agricultural Chemist to the Dolosbage, Matale and Pussellawa Associations, while some sixty visits were made by the members of the staff to various estates throughout the tea districts. The Director and Agricultural Chemist also gave evidence before the Government Committee on Soil Erosion. This evidence stressed the importance of cover crops as opposed to the practice of clean weeding and also advocated more attention to soil management and improved drainage systems. A full report will be found in the November number of the *Tea Quarterly,* and it is satisfactory to find that the suggestions made receive strong support from work in other countries, the results of which have recently been summarised by the Imperial Bureau of Soil Science.

Advisory Work:—A satisfactory feature of the year has been the steady increase in the number of applications made to the Institute for advice in connection with such questions as fungus and insect diseases, manurial and cultivation problems, factory practice, etc. Such advisory work forms an important feature in the work of all sections, and it is clear that the assistance which the Institute is able to offer in this way is becoming more generally realised.

Owing to the absence of Dr. Gadd on leave and the resignation of Mr. Light, special arrangements had to be made for the Mycological and Entomological advisory work during the latter half of the year. We were fortunate in obtaining the co-operation of the Department of Agriculture in meeting this difficulty, assistance being given by Mr. Park and Mr. Jepson.

Fungus Diseases:—It is satisfactory to note that fungus diseases have not been unduly severe during the year. Poria, however, still causes considerable trouble in up-country districts, and in view of the difficulty in dealing with this disease when once well established, the importance of prompt measures as soon as an attack is noticed needs stressing. Diplodia has been troublesome at lower elevations. The view put forward by Dr. Gadd that this disease is primarily a result of a deficiency in the food reserves of the bush at the time of pruning opens up a new line of investigation which is now receiving our attention.

Among stem diseases Wood Rot remains a major problem, and attention may be invited to the *Tea Quarterly,* 1929, Vol. II, page 10, in which this disease was discussed.

Insect Pests:—Owing to the fact that Mr. King, the Institute Entomologist, only arrived in Ceylon at the beginning of December, no detailed entomological report has been attempted this year.

Attacks by mites, usually Red Spider, were more common than usual doubtless owing to the dry weather prevailing in many districts. Several localised but severe outbreaks of Nettle Grub were reported from the Uva district. In view of the importance of dealing with this disease, if possible before it extends to other areas, arrangements were made with the Department of Agriculture for Mr. Austin of the Entomological Division to begin an investigation of the pest and possible methods of control. This work was unfortunately interrupted owing to difficulties in providing suitable accommodation for Mr. Austin in the area affected. Arrangements are now in hand for this work to be taken over by the Institute and a systematic investigation made.

Tortrix was, generally speaking, less in evidence than in the previous year, but continues a serious pest over large areas. Egg mass collection was in force throughout the year, and the opinion of local Associations has been invited as to the desirability of continuing this practice. There can be no doubt that this should be done until further methods of attack are available.

Work on the breeding of *Trichogramma erosicornis,* an egg parasite of Tortrix, was considerably interrupted by Mr. Light's departure, but was continued by the Entomological Assistant under the general guidance of the Director. Earlier in the year, considerable difficulties had been encountered in obtaining a satisfactory rate of increase of the parasite. Later, however, these difficulties were largely overcome and the ratio of parasites emerged to those used for parasitism showed a most satisfactory increase. If maintained there should soon be available a stock of parasites sufficient in number for a field trial of the method to be carried out.

Tortrix, however, is by no means the only pest of tea which may prove susceptible to biological control, and in order that an investigation of wide scope may be undertaken to examine this line of attack, an application was made to the Empire Marketing Board for a grant to finance such an enquiry. The result of this application is not yet known.

Physiological Work:—Reference has already been made to Dr. Gadd's view on the cause of Diplodia and the importance of a physiological study of the tea bush will be clearly realised. Evidence indeed accumulates that in combating diseases of tea and other crops, attention must be focussed not only on the pest concerned and methods for its elimination, but also on those factors which influence the vitality of the bush itself, and its response to cultivation, manures, plucking, pruning, etc. A physiological enquiry again may throw light on other problems such as the factors influencing quality. Realising the importance of this line of advance, the Board decided to appoint a Plant Physiologist to the staff, but Mr. F. R. Tubbs, the officer selected, had not arrived in Ceylon at the end of the year.

Agricultural Chemistry:—The Uniformity Trial referred to in last year's report was continued until the end of the plucking cycle in December, and the data therefrom are being analysed. Important deductions can be made from these results in regard to the magnitude of errors necessarily inherent in field experiments with a crop such as tea, and the methods available for reducing such errors to a minimum. An interesting fact that emerges from this analysis of error is that probably the main factor militating against the reduction of such errors below a certain level is not so much soil heterogeneity or even bush variation as the difficulty in obtaining a definite standardisation of plucking. The results obtained are of the highest value, fully justifying the time and labour spent, and will have an important practical application in determining the lines on which the field experiments at St. Coombs will be laid down in the present year.

The leaf collected from the Uniformity Trials has also been utilised for a preliminary study of the nutritional requirements of the tea crop. An interesting feature of the results obtained is the influence of climatic conditions on the uptake of both mineral nutrients and nitrogen, this being of importance in consideration of the similar relationship between climate and quality established by work in the Biochemical Division.

Mr. Eden has also continued his examination of typical tea soils with special reference to the clay fraction. The results suggest that these soils are intermediate in character between temperate and many tropical soils, and are not truly lateritic in character.

Biochemistry:—Interesting results have been obtained by the Biochemist concerning seasonal variations in the composition of tea. Analyses show that the 'extract' and tannin content of the leaf vary inversely as the rainfall, and that such seasonal fluctuations persist in the composition of the made tea. There would, in fact appear to be two distinct types of tea. One is a high quality tea possessing strength, body and pungency, made during the dry weather, when the extract and tannin content are also high. The second, also of good quality and pungency, obtained during the wet season, has a low extract and tannin content, but the proportion of tannin to other substances is high. The market valuation of tea is therefore closely related to its tannin content, but cannot be judged solely on this factor without consideration of the other constituents for the results obtained show that the connection between tannin content and valuation can be modified during manufacture, though the extent to which this can be carried is not yet known. A study of the changes occurring during fermentation is therefore of the first importance, and has formed an important part of the work of this section.

The reports of the Scientific Officers are appended.

Acknowledgments:—The acknowledgments of the Institute are due to the Managers and Superintendents of many estates who gladly co-operated with the staff and placed facilities at their disposal, and in particular to Mr. C. D. Sparkes, Manager, and Mr. W. M. Miller, Superintendent of Scrubs Estate for their assistance in the Uniformity Trial, and to Mr. P. G. Boileau of Dunkeld who co-operated in experiments on the making of "artificial" farmyard manure. Our thanks are also tendered to the Director of Agriculture and the officers of the Department who have at all times rendered us all the assistance in their power, and to the Superintendent of the Colombo Observatory for the loan of instruments.

ROLAND V. NORRIS,
Director.

REPORT OF THE MYCOLOGIST.

Until May 8th when he proceeded on leave, the Mycologist, in addition to his own duties, carried out those of Acting Director. After that date the advisory work was continued by Mr. Park of the Mycological Division of the Department of Agriculture. Consequently, little time has been available for active research during the year. The writer is indebted to Mr. Park for assistance in formulating this report.

147 consignments of diseased plants were received for examination and report. Of these, 120 were tea; the remainder consisted of Acacia, Albizzia, Boga, Cassia, Crotalaria, Dadap, Derris, Gliricidia, Grevillea and Gums.

Visits were paid to 17 estates in the Agrapatna, Akuressa, Ambawela, Balangoda, Bagawantalawa, Haldummulla, Hewaheta, Kandapola, Lindula, Madulkelle, Maskeliya, Nanuoya, Ratnapura, Ulapane and Watawala districts.

Root Diseases:—No new root diseases were observed during the year, nor have any of the known diseases become more prevalent. In up-country districts, *Poria hypolateritia* continues to be the most troublesome root disease fungus, mainly because of the difficulty experienced in eradicating the fungus from infected soil. The treatment of this disease was fully discussed in *The Tea Quarterly,* Vol. II pp. 16-21 (1929) to which reference should be made. Emphasis should be made of the necessity for carrying out rigorous measures for the control of this disease as soon as it is noticed and before the infected areas become large. The disease is one of the first to make an appearance in clearings, and it is then that its eradication should be seriously tackled.

At lower elevations the Diplodia disease still proves troublesome in some areas. Now that it is recognised that this disease is primarily the result of a deficiency of food reserves within the bush at the time of pruning, attention is being given to the building up of these reserves and to methods of lighter pruning, with beneficial results. There is a tendency to attribute other diseases and symptoms to a deficiency of internal food reserves, and a warning may here be necessary. There is no reason to believe, and there is much evidence to the contrary, that a deficiency of food reserves is the cause of all the ailments observed in the tea bush. Much harm will be done and the importance of internal reserves will fall into discredit if the building up of such reserves is regarded as the cure or even prevention of all diseases.

Stem Diseases:—Wood Rot (Branch Canker) remains a major problem on many estates, and increased attention is being given to the treatment of already cankered bushes as well as to methods of pruning. The treatment of cankered bushes has been discussed in earlier reports to which little can be added at present. A discussion on pruning in relation to wood rot of tea was published in *The Tea Quarterly,* Vol. II, pp. 10-16, in which amongst other things, the relationship between the position of the wound and its ability to heal was indicated. The promotion of the healing processes is a subject receiving increased attention on many estates as its value in preventing wood rot is becoming recognised. It is not a simple problem, however, as a careful examination of an area of tea will show. It is not an uncommon occurrence to find a bush showing marked and vigorous healing, whereas the adjacent bushes, which, as far as can be ascertained, have received similar cultural treatment and are growing under identical environmental conditions, exhibit no callus growth whatever. The ability to heal readily may be an inherent character, but external conditions and treatment will strongly influence it.

The difficulty of eliminating all infected tissue is the greatest obstacle in the treatment of rotted branches. In some cases most of the infected wood can be removed by scraping; in others, where the rot has progressed through the greater part of the frame, collar pruning has to be resorted to. In some instances collar pruning has given very beneficial results, and new and healthy frames are being built up on the old root system. In others, the pruned bushes are very slow in making new growth, so slow in fact that sometimes they are abandoned as dead. It is not generally recognised that collar pruned bushes may be dormant for long periods as is shown by the following instance for which I am indebted to Mr. S. R. Hamer. A tea bush was collar pruned in March 1927 but gave no sign of new stem growth until 1928, since when the recovery has been most satisfactory, and a fine frame has developed.

Red rust (*Cephaleuros parasiticus*) continues to cause losses in certain areas where tea is grown under relatively unfavourable conditions. This disease is to be regarded as a disease of weak bushes, and where conditions are such that they reduce the general vitality of the bush, red rust is liable to establish itself on the branches. In some instances, red rust has been found to follow the true Branch Canker which is caused by the fungus *Macrophoma theicola*. In such cases the canker reduces the vitality of individual stems sufficiently to enable the red rust to gain entrance. Where this has occurred the infected branch should be pruned out below the cankers, and not merely below the rusted areas.

A dieback of tea branches was prevalent in the Agrapatna, Lindula and Nanuoya districts during the early months of the year. The disease occurred only in fields during the first year from pruning. In general appearance it resembled that usually ascribed to wind injury, but in the cases under investigation strong winds played little or no part in the causation of the disease. When young stems are damaged by wind, the cortex (bark) at the base of the shoots is injured; in some cases a complete ring may be destroyed so that the shoot remains attached to the parent branch by a thin column of wood only. Such injuries result in the death of the shoots. In the cases under consideration there was no mechanical injury of the cortex at the base of the shoot though it was dead, and the shoot withered and died as though it had been ringed. The cause of the disease was not ascertained though it appeared to be influenced by weather conditions. Diseased branches should be pruned out and burnt; the cut should be made through the parent branch just above the next lower healthy shoot.

Leaf Diseases: -Cercosporella continues to be the most important leaf disease of the tea bush at high elevations. Again this year, owing to the mildness of the South-West Monsoon, this disease caused little damage. This and other common leaf diseases have been received for report from time to time, but fortunately none has done serious damage.

Seedling Diseases:—The "Bitten off" disease of tea seedlings continues to do serious damage in nurseries. This disease is sometimes associated with excessive water in nursery beds, and improvement in drainage reduces the incidence of the disease. Prolonged excess of soil water or water-logging of the soil causes the death of the lateral roots and of part of the tap root. The dead roots decay and are left in the ground when the seedlings are pulled. The appearance of the remains of the root system has given rise to the name "Bitten off," though in fact the missing roots are not bitten off. Although the damage occurs at the roots at the time of water-logging, some considerable time elapses before any above-ground symptoms becomes evident, so that when the disease becomes noticeable there is often no direct evidence of excessive soil moisture. Good drainage is essential in nurseries if this disease is to be avoided.

Corticium Vagum, (*Rhizoctonia Solani*) which was reported in the last Annual Report as a leaf disease of mature tea, has been found to cause a similar disease of seedlings in a nursery. The fungus lives in the surface layers of the soil and is one of the commonest disease fungi of seedlings (other than tea) in Ceylon and is the primary cause of "damping off." Its mode of attack on tea is different from that on the majority of seedlings; instead of attacking the plant at ground level and so causing it to topple over, the fungus travels up the stem and attacks the succulent green shoots and leaves. Damp conditions favour the growth of the fungus, so the disease usually disappears as dry conditions set in. Infected beds should be thinned to allow as much light and air to individual plants as possible; this will usually control the disease in tea nurseries.

Collar rot and the eelworm disease of seedlings have also been recorded during the year.

Green Manures:—Diseases of green manure plants received for report have included Red rust on stems and *Irpex subvinosus* root disease of Boga, *Parodiella grammodes* leaf disease of Crotalaria, "Bitten off" disease of *Derris robusta* seedlings, Brown root disease of Gliricidia, and Poria root disease of Grevillea.

C. H. GADD.
Mycologist.

REPORT OF THE AGRICULTURAL CHEMIST.

Advisory:—The year has been marked by an increase in the number of enquiries from estates. 147 letters were received and 146 were despatched. Sixteen visits to estates were made in the following districts:—Badulla, Bandarawela, Deniyaya, Dickoya, Dimbula, Dolosbage, Kalutara, Kandy, Matale, Pussellawa and Uda-Pussellawa.

In addition to the contribution made to the Institute's First Conference, the following lectures have been given:—

"The Part Played by Organic Matter in the Soil"—Dolosbage P. A.

"Soil Colloids—What they are and what they do"—Matale P. A.

"Green Manuring and Soil Conservation"—Pussellawa P. A.

In conjunction with the Director, evidence was given before the Committee appointed by H. E. the Governor to report on Soil Erosion.

SOILS.

General:—Work has been continued on the examination into the fundamental properties of tea soils. In the previous Bulletin the fact was reported that all the soils then examined were distinguished from other typical tropical soils mainly by their moisture relationships. In particular, in common with soils of temperature origin, the soils exhibited a well-defined 'sticky point' at a moisture content lower than that of the 'running point' (Vide Bulletin No. 3). A further batch of soils examined this year has confirmed the previous findings, and no exceptions have occurred. In a further comment on these data in the same report the opinion was expressed that the colloidal portion of the soils might repay more detailed study.

This further development of the investigation has been commenced by an examination of the chemical constitution of the clay fraction. By clay is understood that portion consisting of particles not exceeding 0·002 m.m. in diameter as separated out by mechnical analysis; the fraction that is, which contains all the mineral colloids.

The clay was separated out by sedimentation, and analyses for oxides of iron, aluminium and silicon were made. The methods followed were those of Martin and Doyne (J. Agric. Sci. 1927, XVII, 530), and the object was to classify Ceylon Soils on the lines that these workers have applied to tropical soils in Sierra Leone.

Martin and Doyne have applied definite chemical criteria to the classification of so-called laterite soils, and have recommended that the ratio of silica to alumina in the clay be used to distinguish between the various categories. As a result of their analyses, they suggest the following limiting values :—

Type	Silica/Alumina
True laterite	1·33
Lateritic	2·00
Non-lateritic ... ... >	2·00

Table I gives a selection of the analyses of the Ceylon tea soils so far examined.

TABLE I.

Percentage Composition of Clay Fraction of Ceylon Soils.

Soil	Ferric Oxide	Alumina	Silica	Molecular Ratio SiO_2/Al_2O_3
A 2	12·62	35·31	32·14	1·54
3	nil	38·56	43·56	1·92
B 1	28·23	18·90	33·90	3·04
2	20·97	25·13	33·65	2·27
C 1	11·86	27·26	33·60	2·05
2	13·29	26·92	35·61	2·24
D 1	20·66	18·61	22·92	2·09
2	19·91	26·54	32·82	2·10
3	12·84	31·55	37·44	2·01
E 1	18·23	27·92	28·48	1·68
2	19·53	27·66	30·89	1·89
3	21·06	30·76	34·36	1·54

The last column of the Table shows that none of these soils corresponds to Martin and Doyne's true laterite. Soils A and E would be classified as lateritic in type, whilst B, C and D exceed the determining limit. These results are therefore in keeping with the behaviour of the soils as discussed in the previous report, and to some extent explain why they behave in a fashion similar to temperate soils which are characterised by relatively high ratios of silica to alumina.

The percentage of alumina in the Ceylon soils is high, and is roughly of the same order as that found by Martin and Doyne in their lateritic soils. The lower ratios here exhibited are explained mainly by the higher values for silica. It is therefore of some interest to determine whether this high silica figure is due to an incomplete laterisation of the parent rock in weathering, or whether the clay fraction is augmented by finely divided silica derived from the large reserves of quartz contained in the parent rock. Upon the answer to this question depends the interpretation placed

upon the moisture relationship results. Are they, in other words, due to a real deficiency of lateritic material, or to a large admixture of non-colloidal material ? A study of the degree of correlation between the chemical composition and the moisture relationships and mechanical analysis, will throw light on this when a sufficient body of data for a precise examination is available. This will form the next avenue of approach to the problem of soil classification.

Soil Reaction:—In the course of routine determinations further figures for soil reaction have been accumulated, and further data for poor tea soils having an alkaline reaction are available. As was reported in the previous bulletin these alkaline soils are found to be invariably associated with the sites of former cooly lines or cooly gardens. It seems probable that the cause of this alkalinity is to be sought in the incorporation into the soil of mortar on the one hand, and ashes applied in the normal process of horticulture on the other, the latter being an eminently suitable practice under the circumstances. The coincidence of high reaction and poor tea with these sites is so striking that it seems advisable to warn Superintendents against employing such sites as tea nurseries in future. For grevilleas, gums and green manures generally, no harm is to be anticipated.

PLANT NUTRITION.

In the course of the routine operations of determining the dry weight yield from the Uniformity Trial on the Scrubs Estate, a number of dry matter samples have been collected. These, in addition to providing material for biochemical investigation, have been of considerable interest to this division.

Information is constantly sought on the subject of the nutritional requirements of the average tea crop. Such enquiries can only be completely answered by reference to field experiments on the one hand, and to knowledge of the plant's physiology on the other. Meanwhile a full range of samples of the leaf in conjunction with accurate yields offers possibilities for making a preliminary empirical study of uptake of nutrients prior to the commencement of detailed physiological investigations.

Nitrogen determinations have already formed part of the biochemical routine, and accordingly this division has supplemented these data by similar determinations of ash content, potash and phosphate. As in the case of yield, provision is being made for a systematic analysis of variations due to sampling and season, and for this purpose the field in question has been sub-divided into quarters for nitrogen samples and halves for the mineral nutrients. Considerations of technique and equipment precluded the possibility of dealing with these latter samples on exactly the same basis as those drawn for nitrogen. This report is confined to a consideration of the general trend of results.

From the point of view of nutrient uptake, the total quantities involved are only of secondary importance. The amount indicated by crop analyses is insufficient as a manurial application for a crop of the particular size considered, and in any case no fixed ratio between analytical content and crop requirement is sound or practicable. Such being the case, the most fruitful approach is to use the data to study rates rather than gross quantity, and to compare if possible the crop data with those relating to environmental conditions.

Figure I.

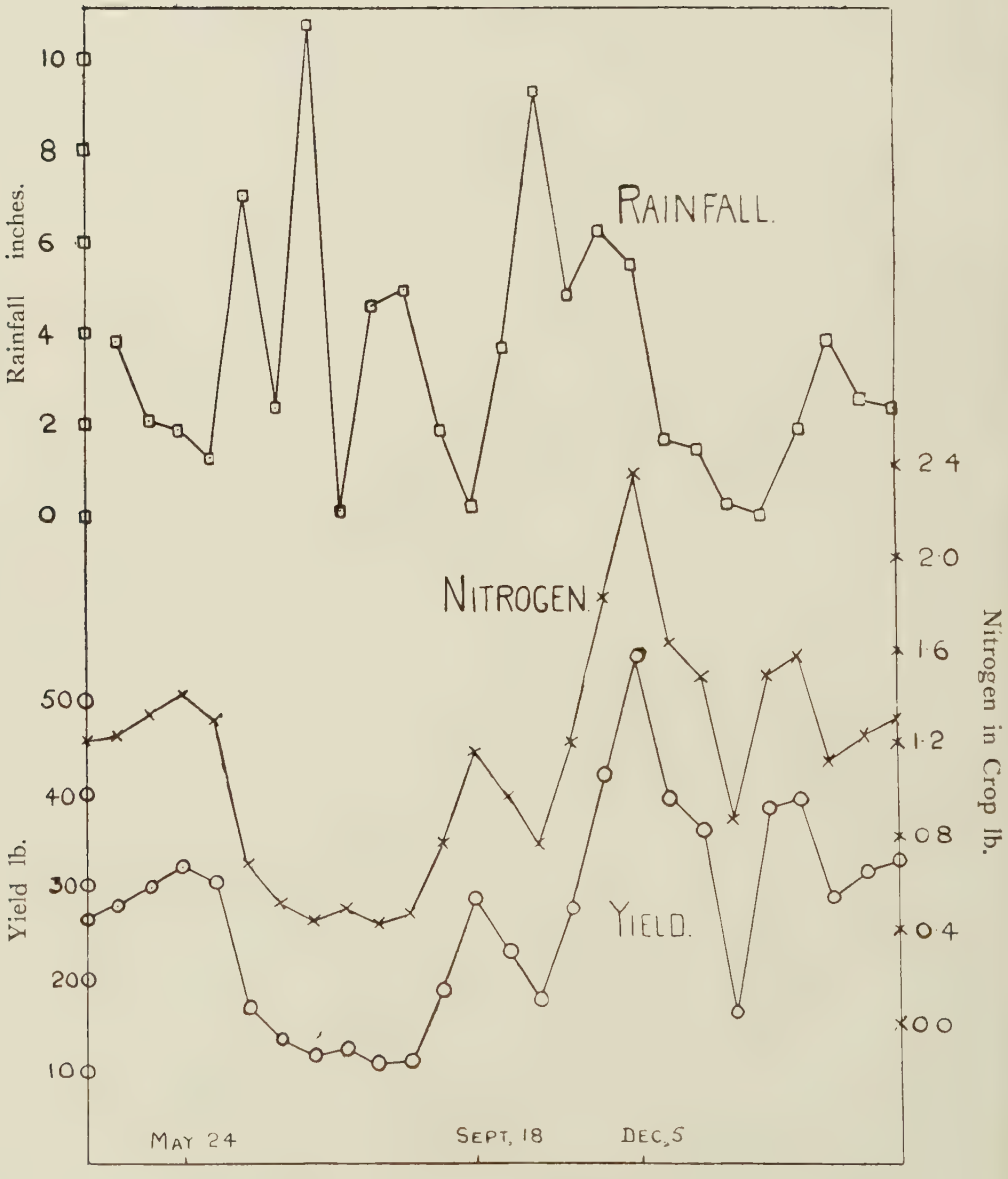

Rainfall inches.
10
8
6
4
2
0
RAINFALL.
NITROGEN.
YIELD.
500
400
300
200
100
Yield lb.
2·4
2·0
1·6
1·2
0·8
0·4
0·0
Nitrogen in Crop lb.
MAY 24
SEPT, 18
DEC, 5

TABLE II.

Yield, Rainfall and Nutrients Removed*

No.	Date	Yield	Rainfall	N in crop lb.	Ash %	Ash in crop lb.
1	Apr. 20, 1928	26·42	—	1·22	4·97	1·31
2	,, 30	27·63	3·75	1·25	4·99	1·38
3	May 11	29·88	2·06	1·34	4·98	1·49
4	,, 24	31·90	1·88	1·43	4·89	1·56
5	June 5	30·41	1·25	1·32	4·12	1·25
6	,, 18	16·85	7·01	0·69	4·63	0·78
7	,, 30	13·37	2·37	0·53	5·10	0·68
8	Jul. 13	11·68	10·72	0·45	4·68	0·55
9	,, 26	12·41	0·10	0·50	4·93	0·61
10	Aug. 7	10·99	4·59	0·44	4·40	0·48
11	,, 18	11·00	4·88	0·48	4·26	0·47
12	Sep. 3	18·81	1·83	0·79	4·79	0·90
13	,, 18	28·62	0·20	1·18	4·85	1·39
14	Oct. 3	22·97	3·62	0·98	4·61	1·06
15	,, 17	17·73	9·20	0·77	4·23	0·75
16	Nov. 1	27·41	4·71	1·21	4·57	1·13
17	,, 17	41·89	6·17	1·84	4·67	1·95
18	Dec. 5	54·76	5·42	2·38	4·75	2·60
19	,, 22	39·39	1·63	1·64	4·92	1·94
20	Jan. 4, 1929	36·00	1·35	1·50	4·90	1·76
21	,, 18	21·45	0·30	0·88	4·95	1·06
22	Fer. 6	38·27	0·05	1·51	4·61	1·76
23	,, 25	39·34	1·82	1·58	4·70	1·85
24	Mar. 13	28·59	3·81	1·13	4·51	1·29
25	,, 27	31·67	2·50	1·24	4·61	1·46
26	Apr. 10	32·81	2·32	1·32	4·54	1·49
Total		702·25	83·54	29·60	122·16	32·95
Mean		27·01	3·34	1·14	4·70	1·27

* Nitrogen percentage will be found in the table on page 27 *et seq.*

Considering first the primary yields set out in Table II, the complete year's record shows considerable variation. The total yield of dry matter (an interesting reflection on made tea) amounted to 702 lbs. per acre with a mean plucking average of 27 lbs. per acre. The lowest yield was 11 lbs. or about 41 per cent. of the mean, the highest 54·8 lbs., or 203 per cent. The yield curve shows that the period of greatest depression was mid-June to mid-August, and the highest peak early December; the former a period of high rainfall, low temperature and sun intensity, the latter when rain, temperature and sun were favourably balanced.

Examining the data in more detail in conjunction with the rainfall figures, Table II and Fig. I, two distinct periods are found: (1) a period when high rainfall gives low yield, *i.e.*, a negative correlation between rain

and yield, and (2) a period when decrease in rain is accompanied by decrease in crop, *i.e.*, a positive correlation. The former relationship is probably a true one; the latter is probably as much due to low night temperatures as to lack of moisture.

The composition of the leaf is seen to vary considerably at different times of the year, but the records are not extensive enough to justify any establishment of a stable relationship between incidence of rainfall and nitrogen content. They suggest for further investigation that high nitrogen is associated with rapid growth and so precedes high yields.

From the point of view of manurial practice, more importance attaches to the fluctuations in total nitrogen removed from the soil by the crop since such data show how the nitrogen demand is distributed over the season. It is at once observed (Fig. 1) how similar the yield and nitrogen curves are. The nitrogen content forms but a small part of the leaf and variations in composition, great as they are considered alone, make no appreciable contribution to the fluctuation in total nitrogen. In interpreting this parallelism, the possibility that nitrogen fluctuations are real fluctuations in soil nitrogen availability and are thus influencing yield is ruled out by a number of considerations. One of these, supplied by the data under consideration, is that the corresponding curve for ash content is almost identical, although the factors which influence availability in the two cases are markedly different. Consequently, the parallelism is to be interpreted as showing that crop fluctuations and their predetermining causes are responsible for the nitrogen fluctuations and not *vice versa*. Such being the case, whilst an increase in yield might occur if more nitrogen were available at times of heavy cropping, the indications are that the application of quick acting nitrogenous manures at times of low yield, noticeably in the early part of the S. W. Monsoon, will not be conducive to increased yields except in cases of actual nitrogen starvation.

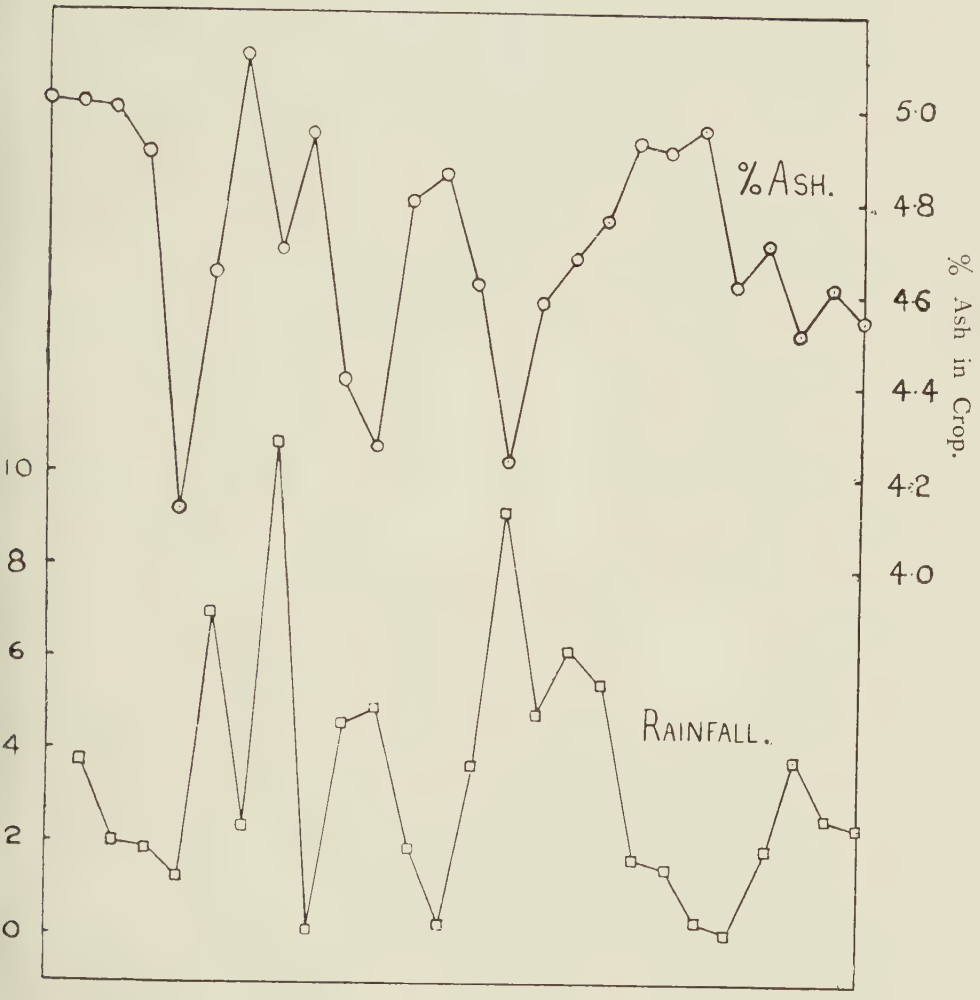
Although the behaviour of the mineral constituents in regard to total quantities removed is similar to that of nitrogen, there is a marked difference in the response of the leaf composition to meteorological changes which was not traceable with any certainty in the case of nitrogen. The ash content of the leaf is associated with the prevailing weather, being high during periods of low ranfall, and low with high rainfall. (Fig. 2).

High rainfall is itself associated with the low radiation of sunless skies. Under such conditions the assimilation of the plant is retarded, and accordingly less demands are made on the mineral portion of the plant nutrients. During the latter part of the experiment a sun recorder has been in operation, and on the later data this association of ash content variation with radiation can be tested directly.

FIELD EXPERIMENTS.

The Uniformity Trial on the Scrubs Estate has been continued throughout the year. The experiment has now been discontinued owing to the approach of the normal pruning period; in all, data from 42 plucking rounds have been collected. These should give satisfactory evidence on questions of plot technique in readiness for experimental work at St. Coombs in the forthcoming season. The full statistical treatment of results is reserved for discussion later, this report being confined to confirmation of previous results and to putting on record additional points of interest encountered.

Figure II.



At the time of writing the 1928 report, the errors of the Uniformity Trial, which were variable from plucking to plucking, showed some signs of increase with diminution of crop. This point has been investigated on a full twelve months' yields which embody the whole range of variable climate. With the more complete data to hand, the relationship has been expressed in terms of the correlation coefficient. This statistical function measures the interdependence of two variable factors, or the degree of common causation. An exact proportionality between changes in the variables would give a correlation of 1·0 which would be positive or negative according as increase in one involved either increase or decrease respectively in the other.

The data for 26 pluckings give a coefficient of correlation between yield and percentage error of—·509. This is not a high correlation but it is statistically significant, *i.e.*, it would have occurred purely as a matter of chance less than once in a hundred times. There is, therefore, evidence that as yields increase errors tend to decrease. This is attributable to such interfering factors as insensitivity of the balance used for weighing and to losses of small quantities of leaf or incomplete plucking, all of which are more serious when the yields are low. The correlation is not high enough for this source of error to be serious.

Another possible cause of variation in error which is of importance is that due to ageing of the bush. From the point of view of the experimentalist it is of interest to know whether irregularities of yields and errors are accentuated as the bush becomes more and more run out towards the end of the pruning cycle. Any tendency, for instance, for the bush to produce buds which do not open in the ordinary way may markedly affect heterogeneity of the plucking with a corresponding effect on error estimation. When error is correlated with age calculated as days from the start of the experiment, a value of + ·558 is found. Again this value is significant but not high, and its interpretation is not straightforward. Since yield and error are correlated, and yield and age, it is necessary to determine whether any correlation between error and age is largely contributed by change in yield. A further correlation is therefore necessary between error and age from which the disturbing influence of yield variation is eliminated. Such a partial correlation gives a value of + ·430. It is evident that yield was having appreciable effect since the correlation is diminished by its elimination. The value is now closer to the border line of significance, and at the moment it is not evident that age has any effect on size of error. It will be necessary to test this point later on the completed data.

The scope of the experimentation with plot arrangement has been extended this year to cover the randomised block system as well as the latin square. The former is more suited to experiments in which a comparatively large number of treatments is contemplated. It is not however so accurate since those elements of variation which are due to local position and are common to all treatment comparisons and can thus be eliminated, are not so adequately controlled.

The difference in accuracy is seen by comparing errors of plots, identical in size and number, treated according to the two systems. Table III gives the complete figures for the year.

TABLE III.

Standard Error Per Cent of One Plot.

Plucking	Latin Square	Randomised Block
1	6·6	13·0
2	9·3	12·7
3	9·9	10·8
4	7·2	10·9
5	13·2	19·0
6	10·8*	10·4
7	9·3	12·3
8	12·3	16·6
9	10·2	12·8
10	10·9	13·0
11	14·3	20·2
12	14·9	24·8
13	11·9	12·9
14	6·2	19·7
15	9·7	14·4
16	11·5*	7·9
17	13·0	16·7
18	12·6*	12·3
19	11·0	12·8
20	8·2	12·4
21	14·7	25·5
22	13·3*	12·5
23	12·5	21·4
24	15·2	15·6
25	10·5	18·8
26	10·3	13·6
Mean	12·45	16·08

On only four occasions does the block method equal or exceed in accuracy the latin square. These can all be traced to abnormally low values for either row or column variation in the latin square.

When the yields over a number of pluckings are amalgamated before examination, the error is decreased, the plot variation over a period being less pronounced than the mean variation of a number of individual pluckings. Herein lies the advantage of running an experiment over an extended period. Table III shows that the mean error of a single plucking is 12·45 per cent. for a single plot. The corresponding error for the mean of 4 plots is half this value, 6·23 per cent. The error for the mean quadruplicates derived from the amalgamated yields over the year is 3·86 per cent. This decrease in error by taking yields over a period does not proceed indefinitely; there remains a characteristic variation which the accumulation of pluckings cannot remove. In the last report 12 pluckings gave a standard error of quadruplicates of 4·01 per cent. The addition of an extra 14 has only reduced this by 0·14 per cent., and no further great reduction can be expected. Nevertheless, although it seems probable that the continuance of the experiment for a further period of one or two years will not reduce the errors, the pruning cycle is the only sound period to adopt, and the time period cannot be cut down to that at which minimum errors are first encountered.

On a portion of the data an analysis has been made with a view to tracing the cause of this early arrest in the decrease of error. The result of that analysis leaves no doubt that the cause is not soil heterogeneity, or even bush variation, but that it is due to a failure to obtain a definite standardisation of plucking.

As was shown in the previous report, the design of the experiment allows for the fact that one plucker will pluck to a slightly different degree of coarseness than another, but it cannot allow for the fact that a plucker's individuality is not constant from plucking to plucking. This, besides affecting actual yield brought in for weighing, affects potential yield on the next occasion. A bush insufficiently plucked or stripped too much is biassed against the production of the succeeding flush.

These conclusions are drawn from the behaviour of the variation of the plots from top to bottom and from side to side. The different rows give different yields, but the highest yielder on one occasion is not always the highest yielder on all other occasions. If the rows are arranged in rank according to yield, their rank continually changes. The same holds true for the columns. The row totals show more divergency over the whole period than the columns and their consistency in rank is high. The column totals show over the whole period a less divergency, but their fluctuations in rank from time to time referred to above are twice as large as those for rows. This can be accounted for only if there is some disturbing factor introduced into the column totals which does not affect row totals. Such an effect is contributed by the plucker. All rows are plucked by the same plucking band and are affected equally by changes in the individuality of the plucker. The columns are each plucked by separate bands, and any change in standard of plucking goes to swell the figure which measures the inconsistency of rank from time to time. This variability of even a carefully supervised plucking gang constitutes one of the most difficult aspects of experimental technique with tea, and may well account for much of the conflicting data which has been recorded heretofore.

SUMMARY.

(1) The soils examined for physical characteristics continue to give results which place them in an intermediate position between temperate and many tropical soils. An examination of the clay fraction of these soils shows that their chemical composition is in keeping with these findings and that they are not true laterites.

(2) The harmful effect of alkalinity of tea soils has received further confirmation, and sites of former cooly lines and gardens are further rendered suspect in this matter.

(3) The analyses of the tea leaf for mineral nutrients and nitrogen show that climatic conditions are mainly responsible for the large fluctuations in total nutrients removed, and that manuring should consequently be fitted in to the seasonal cycle if losses are not to be encountered.

(4) A further examination of the causes of variation in errors of tea experiments has failed to show as yet that age from pruning has any marked effect. The seriousness of the individuality of the plucker from round to round has been demonstrated, and its effect on the stabilisation of the error at high values examined.

T. EDEN,
Agricultural Chemist.

REPORT OF THE BIOCHEMIST FOR 1929.

Advisory:—Ninety-three letters have been received and eighty-three sent out during the year, and visits made to seven estates in the Nuwara Eliya, Hatton, Katugastota and Kadugannawa districts.

In addition to several articles in the *Tea Quarterly*, a paper was read at the Tea Conference held in March on "Some Problems of Tea Manufacture," and an address given to the Dimbula Planters' Association in December on "Tea Fermentation.

Research:—The main work during the past year has been the continuation of the investigation outlined in the 1928 Report. This involved the analysis of the leaf samples from field plots investigated by the Agricultural Chemist, and of the tea samples sent in from different estates. Details of the method of sampling and analysis will be found in the Annual Report for 1928. These investigations are almost completed and as the whole of the data collected will be ready for presentation soon, it is not proposed to deal here very fully with the work done.

SEASONAL VARIATIONS IN THE COMPOSITION OF TEA.

(1) **General:**—All the data obtained are not included in this Report, but the results given in Tables I, I` and III are typical of the analytical results found, and serve has a basis of discussion. On examination the tables it will be found that composition of the fresh leaf and tea varies considerably. The lowest percentage of water-soluble material in Table II is 35·3 while the highest is 44·8 for leaf from the same plots; and the tannin varies between 14·7 and 19·1. Similar variations are found in the other tables. About 40-50 per cent. of the extract consists of tannin bodies, so that it is not surprising to find that the tannin varies along with the extract. The tannin content and extracts found for the fresh leaf samples in Table II are low when compared with the extracts determined by other workers. According to Carpenter and Harrison (4) the tannin content of fresh tea leaf varies between 17·5 and 28·5 per cent. and Deuss (2) gives figures varying from 12·1 for tapping leaf to 27·4 per cent. for leaf plucked towards the end of the pruing cycle. The acid soluble tannin (Table III) is evidently dependent on the amount of total tannin, but the actual amount of tannin bodies removed on acidifying the extract varies during the season. This variation is probably due to slight variation in manufacture, which is easily understood when it is remembered that this substance is formed during fermentation. The actual amount of precipitable tannin does not appear to bear any relation to quality, but the ratio total tannin/acid soluble tannin, which varies from 2·7 to 5 per cent. bears some connection to the valuation. Low priced teas have invariably a small ratio while the better valued teas give a higher figure. The actual ratio in any tea depends on the extent of the fermentation, as the ratio found diminishes during the process of manufacture. It is possible therefore that this relationship may be used as a criterion of manufacture.

The tannin variation does not account for the whole of the change in the water-soluble material as it will be seen in Tables I, II and III that the other substances extracted by water vary in the same way. This non-tannin residue which consists of caffeine and other substances which have not yet been identified comprises the remaining 50-60 per cent. of extract. These substances vary in exactly the same way as the total extract as will be seen from Fig 3. Their range of variation during the season

appears to be the same for the fresh leaf samples and made tea as for Java teas (2). Fluctuations found in these substances appear to be controlled by climatic conditions only, as similar figures are found for teas at all elevations, and its similarity in the fresh leaf and made tea samples lead to the conclusion that this fraction of the leaf does not play an important rôle in the change taking place during manufacture.

The total nitrogen varied between 3·58 and 5 per cent. which is considerably lower than the values found for Indian tea by Carpenter or java tea by Nanninga. The nitrogen, however, varied during the season, and from estates to estate in a manner which is not yet understood. Since the younger leaves contain more nitrogen than older leaves, the actual nitrogen in the pluck will depend to a certain degree on the fineness of plucking, so that the variation from estate to estate may be due to different kinds of plucking. The water-soluable nitrogen (Table II) varies in the same way as the total nitrogen.

The ash content varied between 4·12 and 4·9 per cent. and this is also less than the ash content reported by Deuss (2) for Java teas. The ash content of Java tea varies between 4·7 and 6·9 per cent. and according to Deuss decreases with the age of the bush from pruning. The ash content of the fresh leaf samples does not exhibit this variation, but it appears to be closely related to the extract content.

When the extract is high the ash is high, and low when the extract is low. Nanninga (5) found that the ash content is greatest in the older leaf, so that the actual amount of ash found will depend to a certain extent on the type of pluck. The true ash content is also masked by errors introduced through the adherence of soil particles on to the leaf caused by deposition of dust on the leaf, splashing during rain and various other effects.

(2) EFFECT OF PRUNING ON THE COMPOSITION OF THE LEAF.

It is well known that tipping leaf and subsequent plucks are of poor quality, and the statement that such leaf is deficient in sap, or the sap is thin and watery, is often heard. When the chemical composition of the first few plucks after tipping is determined, a marked difference in chemical composition is found for tipping leaf compared with that of leaf from later plucks. The main field plots did not allow of observations of the change in the composition of the leaf from tipping time, and information on this point has been collected from other plots. The results obtained for different plots are in fairly close agreement, and as an illustration of the variation found some of the results obtained on one plot are given in Table I. Inspection of this table will show that the extract obtained from tipping leaf varied in quantity and quality from that obtained from the leaf plucked later on in the season. The first extract was of a low order and contained only 39 per cent. tannin calculated on the extract, whereas leaf from the sixteenth pluck contained 47 per cent. tannin in the extract. The quantity of extract obtained from this leaf was also very much greater than was obtained from the former. If the strength of the tea made depends on the amount of tannin present, it is obviously impossible to make the same quality tea from tipping leaf as from ordinary leaf. Although the composition of the leaf was subject to variations from pluck to pluck, the general tendency was well marked. The tannin content increased from 12·1 per cent. to 21·5 per cent, and the total and soluble nitrogen decreased gradually.

Carpenter and Cooper (1) also found that the tannin content was low at the beginning of the season, especially in the first plucks, and Deuss (2) report the same for Java teas. Deuss did not determine the soluble nitrogen but estimated the caffeine content which forms a big percentage of the water-soluble nitrogen, and found a tendency for this to decrease in later plucks. Kellner (3) also records the same effect. He found that 70 to 90 per cent. of the nitrogen of fresh tea leaves was in albuminoid form, but that the total amount of nitrogen decreased with maturity. He found a higher content of amino and caffeine nitrogen in the first plucks than in later plucks. The extract obtained from the first few plucks are therefore richer in nitrogenous substances than later plucks, but nothing can be said as to the effect of this on quality.

In the last column is given the ratio of the content of the non-tannin water-soluble constituents to the tannin bodies. This ratio decreased progressively showing that the tannin formed an increasing proportion of the water-soluble material in the later plucks, but after a time this ratio became more stable, and towards the middle of the pruning cycle it only varied between 1·1 and 1·4.

The greatest change took place in the tannin and nitrogen content as the non-tannin bodies, apart from nitrogenous substances, did not show any marked variation. The table ends at the sixteenth pluck, although data have been collected up to the thirty-fourth pluck, but it is evident that the leaf had reached its normal state about the fifteenth pluck, and subsequent variation can be accounted for by fluctuation in the climatic conditions. Since each pluck corresponds to a period of about fourteen days, it follows that this tea had taken about 6-7 months to produce what would be considered a normal leaf after the first tipping. This period will undoubtedly vary for different elevations, and will be modified by the climatic conditions existing at the beginning and during the plucking period.

(3) COMPOSITION OF LEAF AND YIELD OF CROP.

The yield of crop is taken as the amount of soluble material produced per acre, and is obtained from the data referring to yield of dry matter per acre and the percentage extract in each pluck. During the first few plucks the yield increased and the percentage extract decreased. This was followed by a sudden decrease in yield (Figs. 1 and 2) until the end of August, when improved conditions brought about an improvement in crop. This decrease in yield was accompanied by an irregular drop in the extract and tannin content during the same period. The lowest extract, however, was obtained in October, whereas the lowest yield was obtained in August. The increase in crop during November and December was followed by an increase in the extract which continued to improve during January to March when the yield of leaf decreased. Although the actual amount of soluble material depends on the growth of the bush, the proportion of soluble matter in the leaf depends on some other factors.

A rapid growth did not always result in a leaf which was poor in extract as shown by the increase in extract during the rapid growth of November and December. It must be remembered however that the last pluck in October was very low in extract and tannin, and the subsequent increase in these substances was very regular when compared with the rapid fluctuations observed during the period June to October. On the other hand, slow growth found in July to August is accompanied by a low extract, whereas the slow

growth in January to February resulted in a high percentage of soluble matter in the leaf. It is possible that these anomalies are due to a difference in the amount of solar radiation which has not been taken into consideration. The amount of light falling on the leaf is of great importance for the synthetic activity of the bush. One set of conditions may be suitable for efficient assimilation although the growth is not rapid, while, at other times, climatic conditions may be unsuitable for both assimilation and growth. Thus during the monsoon months when the sky is overcast and light is lacking for photosynthesis, growth is very slow. This results in a low yield containing a smaller proportion of soluble matter, while during January and February the growth is slowed up by the cool nights and dry conditions, whereas the bush is supplied with plenty of light to carry on its assimilation. The products of assimilation then attain a higher concentration in the leaf and the pluck is richer in soluble matter. The results of these investigations support this contention to a certain extent.

(4) COMPOSITION OF CROP AND RAINFALL.

On reference to Figs. 1 and 2 it will be seen that the fraction of the dry matter of the leaf which is soluble in water is inversely related to the rainfall. The fluctuations in the rainfall during the period June to September were not sufficient to cause an improvement in the yield, but the tannin and the extract responded very quickly to any variation in the rainfall. The highest tannin contents were obtained in July and September in plucks gathered in a dry period following heavy rain. The tannin thus responded very quickly to rainfall, but this response was modified to a certain extent by the degree to which the climatic conditions affected growth. When the conditions were such that growth was very rapid, the tannin content increased slowly or not at all. The exact conditions which bring about this difference are difficult to explain.

Table III gives the results of the analysis for the same period of made tea from a district subject to similar climatic conditions. When Figs. 1 and 2 are compared with Fig. 3 it will be seen that the composition of the tea varied in a similar way to that of the fresh leaf samples. In both sets the soluble material decreased from April to October, and then increased again to a maximum in February to March, when a decrease set in again, in keeping with the general climatic conditions under which the teas were grown. The rains persisted well on in the year, and improved weather conditions were not observed until October, when an amelioration in the climatic conditions was immediately reflected in the nature of the crop. During the wet weather the percentage extracts of the made tea decreased in a very regular manner until the end of October, which agrees with the general trend of the composition of the fresh leaf samples. The decrease in the extract of the made teas was more regular than that of the fresh leaf samples, but it must be remembered that the fresh leaf samples represent the variation from pluck to pluck of a small area of tea, whereas the made tea samples represent break samples and are more characteristic of the tea made during the month for the whole estate. When the monthly average composition of the fresh leaf is considered, a more regular variation is found to be the result. Towards the end of the year a decided increase in extract took place in the made teas, the maximum extract being found in March. The decrease in extract observed in 1928 was repeated in 1929 in a striking fashion.

The results obtained with the fresh samples indicate that the tannin of the leaf varied with the extract, and this is true in a general way for the made tea. (Fig. 4.) The tannin of the leaf is the substance which changes most during manufacture, and it is not surprising therefore to find a somewhat different relation between the tannin and extract content in made tea when compared with fresh leaf. Since the composition of the fresh leaf and tea varied with the climatic conditions, it is interesting to compare the composition of a tea from a district which is subject to the South-West Monsoon rains with that of a tea grown in a district which experienced dry weather conditions at the same period. Fig. 5 shows the seasonal variations in the tannin contents of samples of tea from Dimbula and Uva. It will be seen that the tannin content of the Uva teas increased to a maximum in the dry months of July-September, whereas the Dimbula teas showed a decrease during this period, which corresponds with rainy conditions in that district. The tannin content of the Uva teas diminished with the onset of the North-East Monsoon rains, while that of Dimbula teas increased. Although the tannin content of the Uva teas increased slightly towards the end of the year, it remained at a low level until about May-June when a rapid increase again took place in 1929 during the period of July-September. We thus find a high extract and tannin content in Dimbula teas during December-February, and in the Uva teas during the period July-September. A slight improvement should be observed about July-September or October in Dimbula, and between December and February in Uva. The exact time, of course, will vary from year to year according to the variation in the rainfall.

(4) THE COMPOSITION OF THE CROP AND VALUATION.

The variation in the extract and tannin content from month to month of the fresh leaf followed the rise and fall in valuation except for the month of October, when the percentage soluble material is the lowest recorded. The market valuation of the teas from this estate for October, however, was higher than for the preceding months, and a curious discrepancy is found. Carpenter and Cooper (1) also found that the tannin content of the leaf was about its miximum in August and September, but had a tendency to fall off in October although quality improved after the end of September. October 1928 was a wet month, 12·82 inches of rain being registered, and the yield of crop was low. In view of this it is difficult to explain the discrepancy, unless the smaller crop meant a more careful manufacture, or the finished product had a nicer appearance. The changing demand of the market is another factor which has to be taken into consideration, since this tends to mask the true connection between the composition of the crop and its quality. It is possible that buvers know from experience that high quality tea comes from Uva during the dry period, but is lacking in quality during October-November, whereas Dimbula teas improve at this time. The result of this is a keener competition for the quality teas of Uva during the dry months, and a closer attention to Dimbula teas when the quality season is over in Uva. This demand for certain teas at different periods will then give such teas a greater value than one would expect from their chemical composition in spite of the closeness of the relation between the nature of the crop and its intrinsic value. On the other hand, a very close connection between tannin content of fresh leaf and quality cannot be expected unless the conditions of manufacture are always the same. When there is a rapid growth of leaf, it is

not always possible to devote the same care to the manufacture, and the climatic conditions are not always the best for withering when the crop is large so that the quality of the tea suffers. A high tannin content in the leaf manufactured under such conditions would indicate a better quality product than would be really obtained, whereas a low tannin content with a small crop may correspond to a product which has been very carefully manufactured resulting in the optimum utilisation of those components which compose the liquors of the made tea.

If the market valuation is taken as an indication of quality, then the conclusion that the chemical composition of the made tea indicates good quality in January-February for Dimbula, and in July-September for Uva, agrees well with the judgment of the market for 1928 and the part of 1929 referred to. The tannin content, however, is more closely related to the valuation than the extract, and Fig. 4 shows in graphical form the run of the valuation and tannin content of teas made on one estate during 1928 and part of 1929. The curves speak for themselves, and show a very close parallelism between the tannin and valuation. It is not a chance relationship for this holds true for the other teas analysed, and is well illustrated by the data for acid-soluble tannin given in Table IV.

TABLE IV.

		% Acid-soluble Tannin		Valuation in Cents
Estate A	...	10·2	...	128
	...	11·6	...	166
	...	13·0	...	178
Estate B	...	11·3	...	101
	...	12·3	...	113
	...	13·2	...	119
Estate C	...	12·7	...	120
	...	13·4	...	133
	...	14·8	...	139

The valuation thus increases regularly as the acid-soluble tannin increases, but when the teas from different estates are compared, it will be found that the unit values of the tannin in the teas varies. Thus Estate A has considerably higher value per unit than B and C, which also differ from each other. This may be due to several factors; either the teas from Estate A have some oustanding characteristic inherent in the crop, or else the manufacture has been such as to produce a better looking or more uniform product which is in demand by the market. The great care taken with the manufacture and the resulting improvement observed during recent years in these teas support the contention that the higher unit value of these teas is a direct result of careful and rational methods of manufacture. There is also a closer relationship between the chemical composition and market valuation in the higher priced teas than in the low priced teas. The latter are subject to greater market fluctuations than the former, so that any conclusions drawn from their analysis are liable to be upset by the changed demand of the market. The lower grade teas are often judged by the strength of their liquors, which depends to a great extent on the manufac-

ture. Modifications in the liquors brought about by different conditons of manufacture will therefore tend to mask the normal relationship between the chemical composition and the valuation.

It is interesting to find an increase in the tannin content during July, August and September (Fig. 4) at a time when the extract is low. This period corresponds to an appreciation in the valuation of these teas as indicated by the tannin content, but not by the extract. Although these teas are of good quality, the analysis stamps them as a different type from the January teas. One is a high quality tea made in the dry weather, possessing strength, body and pungency, associated with a high extract and tannin content, and the other is a good quality tea obtained in the wet season, which is low in extract, but in which the proportion of tannin to other substances is high.

These investigations show:

(1) The soluble extract, including the tannin in the tea leaf, was strongly affected by climatic conditions in 1928 and 1929, when the extract and tannin varied inversely as the rainfall.

(2) The seasonal fluctuations in the chemical composition of the fresh leaf persists in the composition of the made tea.

(3) The first few plucks after pruning were rich in nitrogen, but low in tannin. Subsequent plucks had lower nitrogen and higher tannin contents.

(4) The connection between the chemical composition of the leaf and the yield of leaf appears to be complex. When the yield decreased as a result of heavy rain during the period June-October, the soluble material in the leaf also decreased, and when the yield increased, as a result of better weather conditions in the subsequent months, the extract also increased. On the other hand, when the yield diminished, as a result of dry and cold weather conditions in December to March, the extract increased, so that slow growth is not always accompanied by the same accumulation of soluble material in the leaf.

(5) The tannin content varied in the same way as the extract, but since the other soluble components of the leaf varied in the same way, the proportion of tannin in the total extract varied during the season.

(6) The market valuation of the tea is closely related to its tannin content; and periods which produced high quality teas produced teas which had a high tannin content. The extract may or may not be high at the same time.

(7) The quality of tea depends on many complex factors, both controllable and uncontrollable. In the first place it is evident that the quality depends on the composition of the leaf, and the most important component is the tannin fraction. However, no deduction can be made as to quality from observations of the tannin content unless the other constituents are also taken into consideration, and the connection between the tannin content and valuation can be modified during manufacture to an extent which is not yet known.

D. I EVANS.

TABLE I.

Effect of Pruning on the Composition of the Tea Leaf.

(Calculated as percentage of the dry matter of the leaf.)

Pluck No.	Total solids in water extract.	Tannin	Other water soluble substances	N_2 in extract	Total N_2	Non-Tannin / Tannin
1	36·5	12·1	20·7	1·92	4·93	2·05
2	40·4	14·2	21·1	1·94	4·91	1·85
3	41·1	15·0	22·2	1·91	4·86	1·74
4	39·3	14·2	21·1	1·84	4·92	1·78
5	39·5	13·7	20·3	1·80	4·69	1·88
6	38·9	14·2	21·4	1·77	4·42	1·74
7	41·2	16·0	20·8	1·72	4·54	1·57
8	39·5	15·0	21·3	1·64	4·42	1·63
9	38·5	14·7	20·9	1·64	4·53	1·62
10	39·2	13·9	21·2	1·63	4·48	1·82
11	41·9	16·4	21·7	1·73	4·43	1·55
12	43·2	18·4	23·0	1·70	4·29	1·35
13	42·6	18·0	22·5	1·51	4·11	1·37
14	42·8	18·7	22·2	1·59	—	1·29
15	44·1	20·5	20·4	1·65	4·29	1·15
16	43·7	20·5	20·6	1·57	4·28	1·13

TABLE II.

Variation in chemical composition of fresh tea leaf.

(Calculated as percentage of the dry matter of the leaf.)

Date of Pluck	Total solids in extract	Tannin	Other substances	N_2 in extract	Total N_2
22-4-28	44·8	18·5	26·3	1·89	4·63
30-4-28	44·2	18·4	25·8	1·74	4·52
11-5-28	43·8	18·1	25·7	1·71	4·50
24-5-28	43·0	18·0	25·0	1·65	4·48
5-6-28	42·8	18·5	24·3	—	4·35
18-6-28	39·4	17·4	22·0	—	4·09
30-6-28	40·8	18·8	22·0	—	3·99
26-7-28	42·3	19·2	23·1	1·32	4·00
7-8-28	40·5	17·7	22·8	1·49	4·00
18-8-28	38·3	16·8	21·5	1·66	4·40
3-9-28	40·2	19·1	21·1	1·50	4·19
18-9-28	41·3	19·0	22·3	1·51	4·12
3-10-28	40·2	15·6	21·2	1·46	4·25
17-10-28	35·3	15·2	20·1	1·38	4·29
1-11-28	37·2	16·3	20·9	1·53	4·42
17-11-28	39·4	16·8	22·6	1·52	4·44
5-12-28	39·4	17·5	21·9	1·47	4·31

TABLE II.—*(Contd.)*

Date of Pluck	Total solids in extract	Tannin	Other substances	N_2 in extract	Total N_2
22-12-28	40·9	17·7	23·2	1·50	4·18
4-1-29	40·2	17·4	22·8	1·39	4·18
18-1-29	41·0	18·4	22·6	1·43	4·10
6-2-29	40·6	17·5	23·1	1·33	3·99
25-2-29	41·3	18·5	22·8	1·40	4·02
13-3-29	40·2	18·0	22·2	1·39	3·95
27-3-29	40·8	18·0	22·8	—	3·93
10-4-29	39·0	17·0	22·0	1·44	4·03
25-4-29	39·3	17·6	21·8	1·44	4·18
11-5-29	36·8	15·7	21·1	1·35	4·03
27-5-29	36·6	15·4	21·2	1·33	3·93
10-6-29	37·5	16·6	20·9	1·29	3·98
24-6-29	35·8	15·3	20·5	—	3·76
9-7-29	37·7	17·1	20·6	—	3·66
26-7-29	37·7	15·8	21·9	—	3·58
13-8-29	38·7	15·6	23·1	1·29	3·89
26-8-29	38·5	15·2	23·3	1·40	4·25
10-9-29	38·1	15·0	23·1	1·37	4·21
26-9-29	36·8	14·7	22·1	1-41	4·25

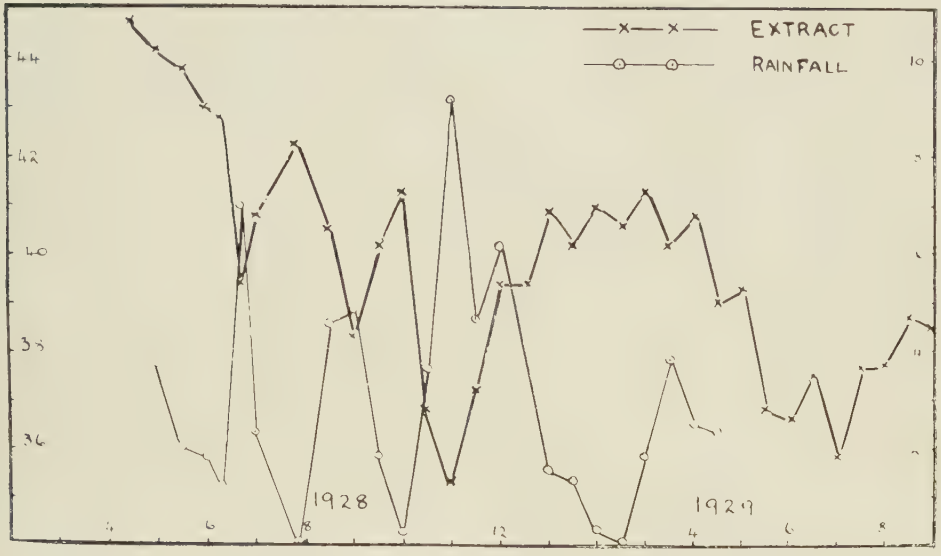
TABLE III.

Variation in chemical composition of made tea.

(Calculated as percentages on the dried tea.)

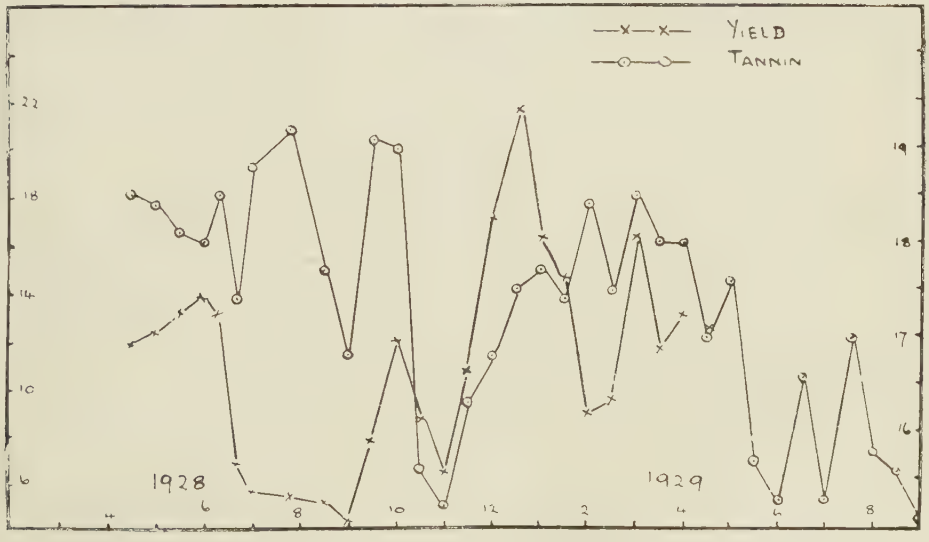
Date	Extract	Total Tannin	Non-Tannin	Acid soluble Tannin	Total N_2	Value in cents.
1928.						
Feb.	43·1	18·9	24·2	14·9	4·62	139
Mar.	44·4	19·6	24·8	15·2	4·49	148
Apr.	41·9	18·7	23·2	14·3	—	131
May.	39·2	17·2	22·0	12·1	4·70	115
Jun.	37·7	17·1	20·6	12·5	4·41	118
Jul.	37·1	18·1	19·0	12·9	4·34	127
Aug.	37·0	18·2	18·8	13·7	4·33	132
Sep.	38·0	18·0	20·0	13·2	4·40	134
Oct.	36·1	16·9	19·2	12·3	—	127
Nov.	38·5	17·6	20·9	13·5	4·22	130
1929.						
Jan.	39·3	18·5	20·8	14·2	4·33	147
Feb.	40·5	18·7	21·8	14·3	4·36	146
Mar.	41·3	17·3	24·0	13·5	4·26	140
Apr.	39·3	17·6	21·7	13·9	4·39	124
Jun.	37·9	17·5	20·4	12·2	4·62	113
Jul.	37·4	17·8	19·6	12·3	4·44	116
Aug.	36·3	17·3	19·0	12·1	4·12	118
Sep.	37·2	18·7	18·5	12·8	4·39	120

Figure I.



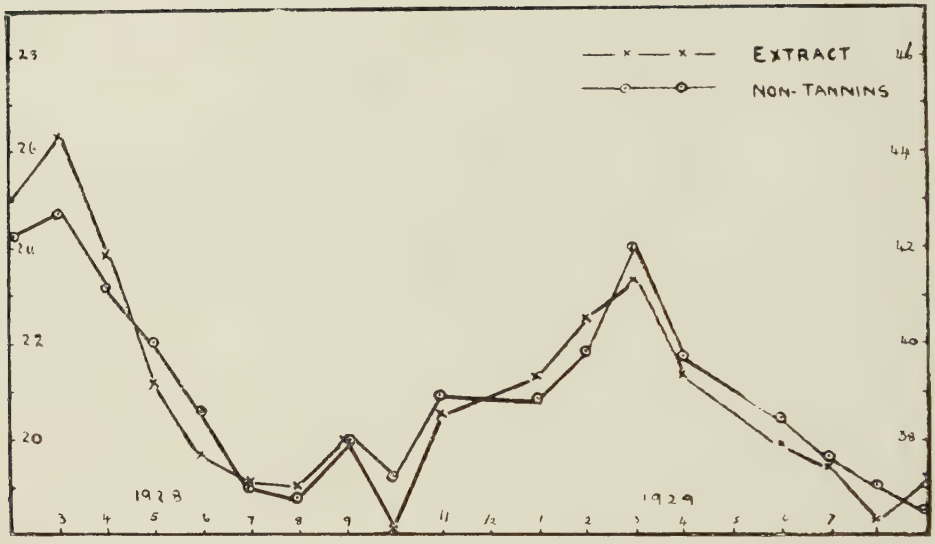
Month in which Crop was Harvested.
Variation of Extract and Rainfall.

Figure II.



Month in which Crop was Harvested.
Relation between Tannin and Yield of Soluble Material.

Figure III.



% Extract in Leaf.

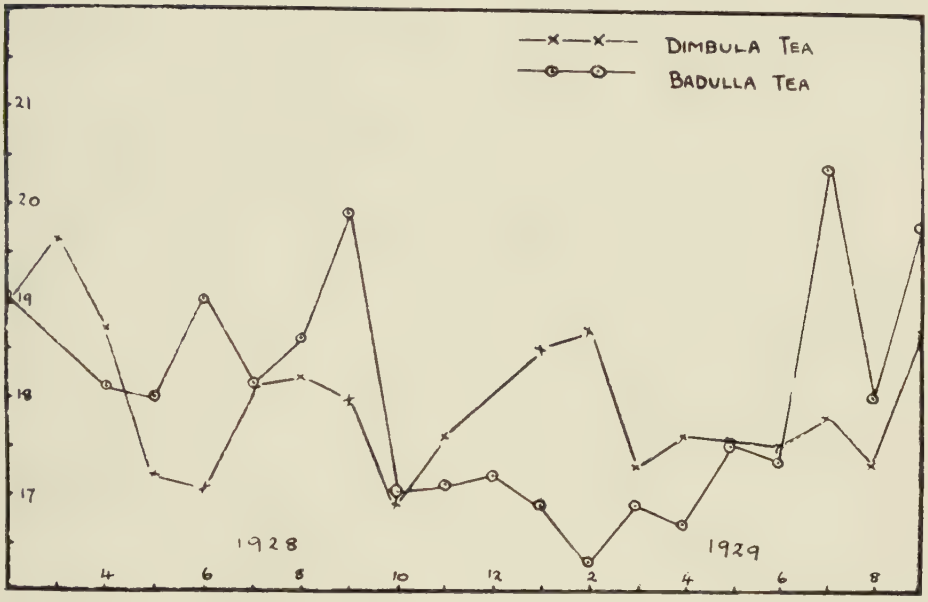
Month in which Crop was Harvested.
Relation between Non-Tannin Fraction of Leaf and Total Extract.

Figure IV.

% Tannin in Tea.

Month in which Tea was Manufactured.
Variation of Tannin Content of Tea with Valuation.

Figure V.



Month in which Tea was Manufactured.
Comparison between Dimbula and Badulla Teas.

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(1) Carpenter, P. H. and Cooper, H. R., Quarterly Journal, Indian Tea Association, 1922, II, 44.

(2) Deuss, J. J. B. Archief v.d. Theecultuur, 1928, 1 and 2, 124.

(3) Kellner, O. Reference from "Chemistry and Agriculture of Tea" K. Bamber, 1893, Appendix III, VI.

(4) Carpenter, P. H. and Harrison, C. J. "The Manufacture of Tea in North-East India," 1927, 4.

(5) Nanninga, A. W. Meded. uit'Slands. Plant. 1904, LXV and LXII, deel 1 en 2.

REPORT OF THE ENTOMOLOGIST.

Correspondence:—112 enquiries were received in connection with tea pests, whilst 12 concerned green manure trees.

PESTS OF TEA.

Tea Tortrix:—23 letters were received about Tea Tortrix.

Experimental breeding of the Tortrix egg parasite (*Trichogramma erosicornis* Westw.) continued throughout the year and proved amenable to laboratory handling. The ratio of parasites emerged to those used for parasitism improved steadily towards the end of the year, and showed that there would probably be no difficulty in maintaining the ratio at about 15 :1. The eggs used for breeding the parasite were at first those of the Agonmois Grain Moth (*Sitotroga cerealella*), but towards the end of the year another moth was used, *Corcyra cephalonica*, which appeared to be more suitable for the following reasons :—

(1) The egg is a little larger than that of Sitotroga.

(2) The eggs do not stick together like those of Sitotroga.

Parasites bred from Sitotroga eggs are uniformly smaller than those from Tortrix eggs, while those from Corcyra are almost normal. The number of moths and eggs obtainable fell off greatly towards the end of the year which was no doubt due to unsuitable conditions, but these can be improved. Maize is used for breeding the moths.

Nettle Grub:—Investigations during six months of the year have been carried out by the Entomological Division, Department of Agriculture. Arrangements are now being made by the Institute to establish an Entomologist in the Uva District to study the Nettle Grub problem.

Bag Worms:—Ten enquiries were received in connection with these pests which do not seem to have been in so much evidence as in previous years.

OTHER LEAF EATERS.

A few enquiries were received regarding Cutworms (*Agrotis ypsilon* Rott.), the Dadaps caterpillar (*Eupterote sp.*), the Tea Leaf Roller (*Gracilaria theivora*), Weevils (*Astycus spp.*), Red Slug (*Heterusia cingala* Moore), the Lobster Caterpillar (*Stamopus alternus* Wlk.), *Dasychira* spp. and Snails.

Mites:—21 enquiries relating to Mites were received, Red Spider being the commonest.

Other pests reported from time to time were *Helopeltis* sp. (7) Shot-hole Borer (*Xyleborus fornicatus* Eichh) (4), and Tea Aphis (*Toxoptera aurantii* Boy.) (2).

Brown and Green Bug (with which is included Black Blight) and Termites continued to be dealt with by the Division of Entomology, Peradeniya, who will deal with them in the future until further notice. All enquiries, therefore, on these pests should be addressed to the Department of Agriculture, Peradeniya.

PESTS OF GREEN MANURE AND SHADE TREES.

The following reports were received concerning the undermentioned trees :—

Albizzia.—Bagworms (1), other caterpillars (2).

Crotalaria:—*Argina argus* Koll. (1)

Dadaps:—*Eupterote* sp. (1), Weevils (1), White Grub (1) Snails (2).

Grevillea:—Termites (1)

Gliricidia.—Aphis (1), Mealy Bug (1).

C. B. REDMAN KING,
Entomologist.

TEA RESEARCH INSTITUTE OF CEYLON.

BALANCE SHEET AS AT 31ST DECEMBER, 1929.

LIABILITIES.

			Rs. Cts.
GOVERNMENT OF CEYLON :—			
Loan @ 6% per annum secured by Mortgage ...	Rs.	1,000,000·00	
Less Repayment ...	,,	18,227·00	
		981,773·00	
Add Interest accrued ...	,,	14,726·59	996,499 59
FUNDS ACCOUNT :—			
As at 31st December, 1928	Rs.	408,656·41	
Add Excess of Income over Expenditure for 1929	,,	96,278·06	504,934 47
			Rs. 1,501,434 06

ASSETS.

			Rs. Cts.
PROPERTY :—			
St. Coombs Estate at Cost	Rs.	600,000·00	
Extensions, New Clearing etc.	,,	33,617·35	
Preliminary and Legal Expenses	,,	33,308·10	663,925 45
BUILDINGS :—			
Expenditure to 31st December, 1929			233,567 80
MACHINERY AND TOOLS :—			
Expenditure to 31st December, 1929 ...			99,642 27
SUNDRY DEBTORS			237 94
ESTATE SUPERINTENDENT'S ACCOUNT CURRENT ...			12,345 42
CEYLON ASSOCIATION IN LONDON £276-4-1 @ 1/6 ...			3,682 73
ACCRUED INTEREST ON FIXED DEPOSITS			1,935 61
CASH :—			
Bank Current Account, Colombo	Rs.	235,806·80	
do Nuwara Eliya	,,	54·01	
Fixed Deposits with Bank	,,	250,000·00	
In Hand	,,	236·03	486,096 84
			Rs. 1,501,434 06

We have audited the books of the Institute kept by the Planters' Association at Kandy, in which are incorporated the Estate Returns. We have not audited the Estate Accounts.

Subject to the foregoing, in our opinion, the above Balance Sheet is a full and fair statement properly drawn up so as to exhibit a true and correct view of the state of the Institute's affairs as shown by the books of the Institute kept at Kandy.

FORD, RHODES, THORNTON & Co., *Auditors.*
Chartered Accountants.

Colombo, 3rd March, 1930.

TEA RESEARCH INSTITUTE OF CEYLON.

Dr. ESTATE WORKING ACCOUNT FROM 1ST OCTOBER, 1928 TO 31ST DECEMBER, 1929. Cr.

	Rs. Cts.			Rs. Cts.
To Expenditure	86,677 28	By Tea Sales	114,016 lbs.	114,414 45
,, Balance Carried to Income and Expenditure Account	27,737 17			
	Rs. 114,414 45			Rs. 114,414 45

Dr. INCOME AND EXPENDITURE ACCOUNT FOR 1929. Cr.

		Rs. Cts.		Rs. Cts
To Administration of the Board :—			By Balance from Estate Working Account	27,737 17
Planters' Association of Ceylon	Rs. 6,000·00		,, Tea Cess	252,012 14
Secretary's Salary ...	,, 2,400·00		,, Interest	26,668 12
Travelling Expenses ...	,, 1,525·46		,, 1927 Tax Refunded	40 00
Postage	,, 281·06			
Stationery	,, 1,166·31			
Advertising ...	,, 694·93			
Telephone	,, 55·74			
Telegrams, Commission etc.	,, 920·33			
Printing	,, 265·11			
Legal Charges ...	,, 775·33			
Audit Fee and Expenses ...	,, 286·96			
Sundries	,, 101·20	14,472 43		
,, Personal Emoluments of Scientific Staff :—				
Director	,, 18,190·31			
Mycologist	,, 17,574·93			
Bio-Chemist	,, 12,060·00			
Agricultural Chemist ...	,, 10,557·79			
Entomologist	,, 8,926·16			
Plant Physiologist ...	,, 1,666·67			
House Allowances ...	,, 6,193·67	75,169 53		
Carried Forward :—		Rs. 89,641 96	Carried Forward :—	Rs. 306,457 43

TEA RESEARCH INSTITUTE OF CEYLON.

Dr. **INCOME AND EXPENDITURE ACCOUNT FOR 1929.** **Cr.**

		Rs. Cts.			Rs. Cts.
	Brought Forward :—	89,641 96		Brought Forward :—	306,457 43
To Laboratories :—					
Subordinate Staff Salaries	,, 3,821·25				
Cooly	,, 288·00				
Rent and Taxes ...	,, 3,868·80				
Insurance	,, 42·50				
Equipment	,, 11,701·50				
Furniture and Alterations	,, 76·92				
Library	,, 1,170·07				
Publications	,, 1,579·04				
House Allowances ...	,, 616·00	23,164 08			
,, Field and Factory Experiments	...	767 60			
To Laboratory Offices :—					
Clerk	Rs. 1,566·00				
Peons	,, 621·62				
Stationery	,, 426·84				
Postage	,, 203·18				
Telephone	,, 180·00	2,997 64			
,, Travelling Expenses of Staff :—					
Officer's Expenses ...	,, 2,125·60				
Car Insurance ...	,, 175·50				
Car Tax	,, 40·00				
Driver's Wages ...	,, 1,137·00				
Driver's Batta ...	,, 176·25				
Running Expenses ...	,, 1,238·68	4,893 03			
,, Contingencies :—					
Incidentals	,, 683·64				
Ceylon Planters' Provident Society	,, 2,844·32				
Passages	,, 9,506·74				
Cart Road ...	,, 30·00	13,064 70			
,, Sundry Estate Expenses	...	923 77			
,, Interest on Loan ...	...	74,726 59			
,, Balance, being Excess of Income over Expenditure		96,278 06			
		Rs. 306,457 43			Rs 306,457 43